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(54) Thermal ink jet printer having printhead transducers with multilevel interconnections.

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Description

This invention relates to thermal ink jet printing systems and, more particularly, to an ink jet printhead of the type having a plurality of channels, each channel being supplied with ink and having an opening which serves as an ink droplet ejecting nozzle a heating element being positioned in each channel, ink droplets being ejected from the nozzles by the selective application of current pulses to the heating elements in response to data signals from a data signal source, the heating elements transferring thermal energy to the ink causing the formation and collapse of temporary vapour bubbles that expel the ink droplets.

Thermal ink jet printers are well known in the prior art as exemplified by US-A-4,463,359 and US-A-4,601,777. In the systems disclosed in these patents, a thermal printhead comprises one or more ink-filled channels communicating with a relatively small ink supply chamber at one end and having an opening at the opposite end, referred to as a nozzle. A plurality of resistors are located in the channels at a predetermined distance from the nozzle. The resistors are individually addressed with a current pulse to momentarily vaporize the ink and form a bubble which expels an ink droplet. As the bubble grows, the ink bulges from the nozzle and is contained by the surface tension of the ink as a meniscus. As the bubble begins to collapse, the ink still in the channel between the nozzle and bubble starts to move towards the collapsing bubble, causing a volumetric contraction of the ink at the nozzle and resulting in the separating of the bulging ink as a droplet. The acceleration of the ink out of the nozzle while the bubble is growing provides the momentum and velocity of the droplet in a substantially straight line direction towards a recording medium, such as paper. In typical applications, ink droplets can be ejected at a rate of 5 kHz, giving rise to process speeds of up to 38 cm per second at 120 spots per cm printing resolution. To achieve practical print speeds, it is necessary to print with arrays of ≈ 20 or more nozzles which are constructed preferably, at the same pitch as pixels to be printed. Printers with small nozzle count use a scanning printhead and typically have print speeds of ≈ 1 page per minute (ppm). In order to print at speeds above ≈ 10 ppm, it is necessary to build a pagewidth print bar which typically contains several thousand jets. With process speeds of 38 cm per second, it is possible to print over 100 ppm with such architectures at 120 spots per cm resolution. Therefore, to enable high through put thermal ink jet print engines, pagewidth print bars are essential.

The printhead design for the prior art systems described above places the thermal energy generators (resistors) on at least one wall of a small diameter capillary tube which contains the ink. The performance of the transducer depends strongly on the distance between the resistor and the nozzle. Drop size, drop velocity, and frequency of ink droplet ejection all depend on the distance between the resistor and the nozzle. 120 spots per cm spi printing performance is optimized when the resistor begins about 120 μm behind the nozzle. The proximity of the resistors to the nozzle, coupled with the high packing density necessary for high density printing have the implication that electrical front lead connection to one end of the resistors must be made across the front of the resistor array. The short distance from the nozzle to the resistor requires the front lead to be narrower than 120 μm . For arrays of jets designed to operate up to a couple of ppm, the configuration where one end of the resistors is connected in common from both ends of the array is satisfactory. The problems with wider arrays, such as pagewidth, emerge because of the resistor energy requirement for printing, coupled with higher common lead resistance.

As mentioned previously, the thermal ink jet process uses rapid boiling of ink for drop ejection. Electrical heating pulses are applied for a few microseconds and must dissipate sufficient energy in the resistor to raise its surface temperature to about 300°C in order for bubble nucleation to occur. Typical energies required for drop ejection are between 10 and 50 microjoules (μJ), depending on the transducer structure and design. It is necessary to apply the energy within a short time, such as 5 μsec . Therefore, about 8 watts are being dissipated during the heating pulse. The current necessary for heating depends on the resistance value of the transducer. If a resistance value of 200 Ω is chosen, then 200 mA of current is required when the device operates at 40V. It is desirable to use high operating voltages so that currents are lowered, but high voltage adversely effects resistor lifetime. Therefore, a moderate voltage such as 40 or 60 V is chosen.

Another requirement of the circuit used for thermal ink jet printing is imposed by the drop ejection frequency ($\approx 5\text{kHz}$ or 200 μsec) and the heating pulse length of $\approx 5 \mu\text{sec}$. Only 40 jets can be fired over the 200 μsec time. Currently yield and process technology allow monolithic integration of up to ≈ 200 jets with good yield. Therefore, 4 or 5 jets must be simultaneously fired. The exact number fired during any particular time depends on the document data being printed. In order for the threshold for drop ejection to be the same when one jet or all jets are fired, the lead which connects the resistors to the power supply must have negligible resistance in comparison with the resistive elements. For the case just discussed, 4 simultaneously fired jets have a total resistance of 50 Ω . Two hundred jets at 120 spots per cm is 1.67 cm.

The width of the metallization in front of the resistors is $\approx 100 \mu\text{m}$, so there is about 170 \square of metal. For typical commercial metal thickness ($1.25 \mu\text{m}$) and deposition techniques, aluminium has a sheet resistance of $0.032 \Omega/\square$. Therefore, the common metal lead has an end to end resistance of 5.5Ω . By connecting the metal on both ends, the resistance seen by the middle 4 resistors is 1.35Ω , or 2.7% of the resistor resistance. From this example, it can be seen that as the number of jets within a module grows, more jets must be simultaneously fired and the parasitic resistance effect caused by the aluminum common connection increases. The practical upper limit before an alternative approach needs to be considered is a consequence of the overvoltage which will be applied when only one resistor element is fired, given that all elements need to fire if selected. Overvoltage increases power dissipation, shortens element lifetime, and causes drop nonuniformity. For the devices considered here, 4 to 6 simultaneously fired jets is the maximum which is practical.

In addition to the problem of the parasitic resistance effect, a second problem when using the aluminium common connection for wide arrays is the connection of the common between a plurality of chips which have been butted together to form the wide array. In order to butt together arrays of modules, each module must terminate so the spacing between it and its neighbours does not give rise to a noticeable and undesirable stitch error. It is well known that printing irregularities as small as $25 \mu\text{m}$ can be seen. Therefore, the modules must be within a few microns of their correct location. As an example, at 120 spots per cm, $84.5 \mu\text{m}$ is the pixel spacing. The thermal ink jet channel structure takes up about $65 \mu\text{m}$, leaving $\approx 20 \mu\text{m}$ for creation of a butted joint. The $20 \mu\text{m}$ joint can not deviate more than $\pm 5 \mu\text{m}$ before perceptible image quality degradation occurs. There is insufficient space at the ends of the module to make a low resistance connection to the common power lead which runs along the front edge of the module. Even when single modules containing many resistors are fabricated and front common leads can be brought out at the ends of the array, it may be desirable to make additional interconnections to the common in order to avoid parasitic voltage drop when many elements are simultaneously fired.

The invention is intended to provide an ink jet printhead in which these problems are overcome.

Accordingly the invention provides such a printhead which is characterised in that said printhead further comprise first and second electrically conductive common returns said common returns being interconnected by leads extending between said heating elements, said heating elements being connected between said first common return and said data signal source by a low resistance connection which is formed beneath or above said second common return.

In The printhead of the invention, the common connection utilized in the prior art is modified by forming two commons and interconnecting them. By providing a second common, the first common located between the resistor and nozzle can be made relatively narrow enabling the resistor to be located at an optimum distance upstream of the nozzle without being restricted by the width of the unmodified wider common. The resistors are connected to the heating pulse source by a low resistance structure which crosses over, or under, the second common. In one embodiment the low-resistance cross-over structure is a heavily-doped polysilicon layer and the second common is aluminium. Other possible combinations include an n + diffusion in a p type wafer and aluminium; refractory metal silicides and aluminium. These embodiments have the effect of decreasing the parasitic resistance associated with the single common and provide additional space to make the interconnection between butted-together chips.

An ink jet printhead in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic perspective view of a prior art bubble jet ink printing system.

Figure 2 is an enlarged schematic perspective view of the printhead shown in Figure 1.

Figure 3 is a top schematic view of an ink channel plate shown in Figure 2.

Figure 4 is a schematic side cross sectional view of a portion of the printhead of Figure 3 showing the resistor to common width and spacing.

Figure 5 is a top view of Figure 4.

Figure 6 is a side view of a plurality of printheads butted together to form a longer array.

Figure 7 is a top view of a portion of a printhead modified, according to the invention, by forming a second common return inter-connected to the primary common.

Figure 8 is a side view of Figure 7.

Figure 9 is a top view of a second embodiment of the printhead.

Figure 10 is a top view of a portion of a second embodiment of a printhead modified, according to the invention, by forming a second common return inter-connected to the primary common.

The printers which make use of thermal ink jet transducers can contain either stationary paper and a moving print head or a stationary pagewidth printhead with moving paper. A prior art carriage type bubble jet ink printing device 10 is shown in Figure 1. A linear array of droplet producing bubblejet channels is

housed in the printing head 11 of reciprocating carriage assembly 29. Droplets 12 are propelled to the recording medium 13 which is stepped by stepper motor 16 a preselected distance in the direction of arrow 14 each time the printing head traverses in one direction across the recording medium in the direction of arrow 15. The recording medium, such as paper, is stored on supply roll 17 and stepped onto roll 18 by stepper motor 16 by means well known in the art.

The printing head 11 is fixedly mounted on support base 19 which is adapted for reciprocal movement by any well known means such as by two parallel guide rails 20. The printing head base comprises the reciprocating carriage assembly 29 which is moved back and forth across the recording medium in a direction parallel thereto and perpendicular to the direction in which the recording medium is stepped. The reciprocal movement of the head is achieved by a cable 21 and a pair of rotatable pulleys 22, one of which is powered by a reversible motor 23.

The current pulses are applied to the individual bubble generating resistors in each ink channel forming the array housed in the printing head 11 by connections 24 from a controller 25. The current pulses which produce the ink droplets are generated in response to digital data signals received by the controller through electrode 26. The ink channels are maintained full during operation via hose 27 from ink supply 28.

Figure 2 is an enlarged, partially sectioned, perspective schematic of the carriage assembly 29 shown in Figure 1. The printing head 11 is shown in three parts. One part is the substrate 41 containing the electrical leads and monolithic silicon semi-conductor integrated circuit ship 48. The next two parts comprise the channel plate 49 having ink channels 49a and manifold 49b. Although the channel plate 49 is shown in two separate pieces 31 and 32, the channel plate could be an integral structure. The ink channels 49a and ink manifold 49b are formed in the channel plate piece 31 having nozzles 33 at the end of each ink channel opposite the end connecting the manifold 49b. The ink supply hose 27 is connected to the manifold 49b via a passageway 34 in channel plate piece 31 shown in dashed line. Channel plate piece 32 is a flat member to cover channel 49a and ink manifold 49b as they are appropriately aligned and fixedly mounted on the silicon substrate. Although only 8 channels and nozzles are shown for illustrative purposes, it is understood that many more channels and nozzles may be formed within a single printhead module.

Figure 3 is a top schematic view of heater plate 49b showing the electrical connection to the bubble generating resistors. As shown, each resistor 50 has an associated addressing electrode 52. Each resistor is further connected to a common return 54. The common return and the addressing electrodes are aluminium leads deposited at the edge of the heating elements. The electrodes 52 can be replaced, if desired, by the drive transistors and logic control circuits disclosed in our co-pending European patent application No. 8.9305819.8. Figure 4 is a schematic cross sectional side view, and Figure 5 a top view, respectively, of the printhead showing the position and spacing of the resistor vis-a-vis the common lead and the channel orifice. The resistors have a typical width of 45 μm and a distance from the resistor to the nozzle 33 of 120 μm is a typical value. The problems associated with the prior art configuration of Figures 1 to 3 can now more readily be appreciated. If the dimensions of the printhead are increased (in the printing direction), and additional jets added, the number of ink jets that must be simultaneously fired also increase. In order for the threshold for drop ejection to be the same when one jet or all jets are fired, the parasitic resistor effect of the aluminium common increases to the point at which drop nonuniformity is experienced. The prior art common interconnection also presents a problem when forming page width arrays by assembling arrays of printheads in a substantially collinear fashion. Figure 6 shows an edge view of a plurality of printheads 11 assembled together. (A preferred technique for accomplishing the assembly is described in EP-A-0,339,912. A problem to be addressed with this configuration is that there is not enough space at joints 60 to make the low resistance connections from each printhead to the common.

According to a first aspect of the present invention, the common lead is modified by providing a second common lead and by interconnecting the thermal, energy-generating resistors to the power source by a low resistance connection. Figure 7 shows a top view, of a printhead with these modifications. The parasitic resistance of the prior art common connection has been decreased by at least 25% with this embodiment with the formation of a second common lead 70. Second common 70 is connected to the first common 54' which, in a preferred embodiment, has been modified by reducing its width. Common lead 70 is connected to common 54' by leads 72 alternating between each resistor 50. The resistance of the second common depends upon the specific application. Resistors 50 are connected to transistor switches 74 by a low resistance connector 76. Common 70 passes over, or under, and is insulated from, connector 76. The table below shows combinations of materials which can be used for interconnections 76 and for the secondary common 70. Connection 78 is the ground return bus and is also preferably formed from aluminum. Transistor switches 74 can be an MOS type formed by monolithic integration onto the same silicon substrate containing the resistor. A preferred process for forming the switches is described in our co-pending European patent application No. 89305819.8. The connector 76, if utilizing structure 1 or 2, has

sheet resistance in the $30-10 \Omega/\square$ size range, which may satisfy requirements for systems with relatively small power dissipation. For applications where it is desirable to fire many jets, or to use resistors with a relatively large power dissipation, the sheet resistance can be lowered further by the use of refractory metal silicide/silicon or metal silicide/polysilicon stacks. (structures 3-4) While the preferred embodiment is aluminium other highly/conductive layers such as tungsten may also be used.

Figure 8 shows a side cross-sectional view A-A of Figure 7. A silicon substrate wafer 60 is processed by the LOCOS (local oxidation of silicon) process to form a thick isolation oxide layer 62. An n + polysilicon layer 64 is deposited, doped and patterned to form the resistors 50; an n + polysilicon layer 65 is formed at the same level to form the low resistance (30 ohm/square) connection 76 to the addressing electrode leads. Phosphorous doped glass is then deposited to form insulating layer 66. Photoresist is applied in pattern to form vias 68, 69 to resistors 64, and connecting lead 65. The wafer is then metallized and aluminum patterned to form aluminum commons 54' and 70. Commons 54' and 70 are preferably in range of 100-300 microns thickness.

TABLE

STRUCTURE NO.	LOW RESISTANCE CONNECTOR 76	CONDUCTORS 54' AND 70
1	n + diffusion in p type wafer	aluminium
2	heavily doped polysilicon	aluminium
3	metal silicide	aluminium
4	silicide/polysilicon	aluminium
5	aluminium	aluminium
6	tungsten	aluminium

Figure 9 shows a second embodiment of the invention wherein the second level connector 65' is an n + diffused silicon layer (structure 1). Layer 65' can be connected to the resistor by aluminum lead 72 or by a direct butting contact between the resistor 64 and diffusion 65'. Referring again to the table, structures 3 and 4 have a similar cross section to 1 and 2, but the resistance of connection 76 is further lowered by formation of a metal silicide with sheet resistance of approximately $1 \Omega/\square$.

Figure 10 shows a top view for an alternative cross-over arrangement to that of the Figure 7 embodiment. For this case, the ground return connection 78 is formed between the transistor switches 74 and the second common 70. A connection 90 is now made between transistor gate 74 and a logic control circuit 92. The gate connection 90 drives only a capacitive driver gate load and therefore can be constructed of polysilicon or diffusion because circuit performance is not impacted by the modest impedance of 10's to 100 squares of sheet resistance exhibited by these layers. For this case, connector 72 crosses over (or under) return connection 78 and attaches to common 70. The same methods of construction discussed for component 76 (Fig 7) can be applied to component 72.

While the invention has been described with reference to the structures disclosed, it is not confined to the specific details set forth but is intended to cover such modifications or changes as may come within the scope of the following claims. For example, although the preferred embodiments show the low resistance connection crossing under the common, some systems may use a cross-over fabrication with the common being buried and the low resistance connector formed in overlying configuration.

Claims

1. An ink jet printhead of the type having a plurality of channels (49a) each channel being supplied with ink and having an opening which serves as an ink droplet ejecting nozzle (33), a heating element (50) being positioned in each channel, ink droplets (12) being ejected from the nozzles by the selective application of current pulses to the heating elements in response to data signals from a data signal source, the heating elements transferring thermal energy to the ink causing the formation and collapse of temporary vapour bubbles that expel the ink droplets, characterised in that said printhead further comprise first and second electrically conductive common returns (54', 70), said common returns being interconnected by leads (72) extending between said heating elements, said heating elements being

connected between said first common return and said data signal source by a low resistance connection (76; 90) which is formed beneath or above said second common return.

2. The ink jet printhead of claim 1 wherein said first and second common returns (54', 70) are aluminium and said low resistance connection is an n⁺ diffusion in a p-type silicon wafer.
3. The ink jet printhead of claim 1 wherein said first and second common returns are aluminum and said low resistance connection is heavily doped polysilicon on a field oxide.
4. The ink jet printhead of claim 1 wherein said first and second common returns are aluminum and said low resistance connection is metal silicide formed on n⁺ or p silicon.
5. The ink jet printhead of claim 1 wherein said first and second common returns are aluminum and said low resistance connection is a silicide/polysilicon stack.
6. The ink jet printhead of claim 1 wherein said first and second common returns are aluminium and said low resistance connection is aluminium.
7. The thermal ink jet printhead of any one of claims 1 to 6 wherein said first common 54' has a width in the range of 25 to 300 µm.
8. The thermal ink jet printhead of any one of claims 1 to 7 further including a transistor switch (74) connected between the resistor (50) and the signal source, said low resistance connection (76) being formed between the resistor (50) and the transistor switch 74.
9. The thermal ink jet printhead of any one of claims 1 to 7 further including a transistor switch (74) connected between the resistor (50) and the signal source, said low resistance connection (90) being formed between said transistor switch (74) and said signal source.
10. An ink jet printer including a plurality of printheads, each in accordance with any one of claims 1 to 9, assembled substantially collinearly, the heating elements of each printhead being connected to the first common and the second commons being interconnected, said second commons terminating toward the rear of the printhead so as to enable routing of power to the heating elements.

35 Patentansprüche

1. Ein Tintenstrahldruckkopf von der Art, der eine Mehrzahl von Kanälen 49a aufweist, wobei jeder Kanal mit Tinte versorgt wird und eine Öffnung aufweist, die als eine Tintentröpfchenausstoßdüse (33) dient, ein Heizelement (50) in jedem Kanal angeordnet ist, Tintentropfen (10) aus den Düsen durch selektive Anwendung von Strompulsen an die Heizelemente in Antwort auf Datensignale von einer Datensignalquelle ausgestoßen werden, wobei die Heizelemente Wärmeenergie auf die Tinte übertragen, wodurch die Bildung und das Zusammenbrechen von vorübergehenden Dampfblasen bewirkt wird, die die Tintentröpfchen heraustreiben, **dadurch gekennzeichnet**, daß der genannte Druckkopf ferner eine erste und eine zweite, elektrischleitende, gemeinsame Rückführung (54', 70) umfaßt, wobei die genannten gemeinsamen Rückleitungen durch Leitungen (72) verbunden sind, die sich zwischen den genannten Heizelementen erstrecken, die genannten Heizelemente zwischen der genannten ersten, gemeinsamen Rückleitung und der genannten Datensignalquelle durch eine Niedrigwiderstandsverbindung (76;90) verbunden sind, die unterhalb oder oberhalb der genannten zweiten, gemeinsamen Rückleitung gebildet ist.
2. Der Tintenstrahldruckkopf des Anspruches 1, in dem die genannte erste und zweite gemeinsame Rückleitung (54',70) Aluminium ist und die genannte Niedrigwiderstandsverbindung eine n⁺- Diffusion in einem Siliziumwafer vom p-Typ ist.
3. Der Tintenstrahldruckkopf des Anspruches 1, in dem die genannte erste und zweite gemeinsame Rückleitung aus Aluminium ist und die genannte Niedrigwiderstandsverbindung stark dotiertes Polysilizium auf einem Feldoxyd ist.

4. Der Tintenstrahldruckkopf des Anspruches 1, in dem die genannte erste und zweite gemeinsame Rückleitung aus Aluminium ist und die genannte Niedrigwiderstandsverbindung Metall-Silicid ist, das auf n⁺ oder p-Silizium gebildet ist.
5. Der Tintenstrahldruckkopf des Anspruches 1, in dem die genannte erste und zweite, gemeinsame Rückleitung aus Aluminium ist und die genannte Niedrigwiderstandsverbindung ein Silicid-Polysilizium-Stapel ist.
6. Der Tintenstrahldruckkopf des Anspruches 1, in dem die genannte erste und zweite, gemeinsame Rückleitung aus Aluminium ist und die genannte Niedrigwiderstandsverbindung aus Aluminium ist.
7. Der Heißtintenstrahldruckkopf nach irgendeinem der Ansprüche 1 bis 6, in dem die genannte erste, gemeinsame Leitung (54') eine Weite im Bereich von 25 bis 300 µm hat.
8. Der Heißtintenstrahldruckkopf nach irgendeinem der Ansprüche 1 bis 7, der ferner einen Transistorschalter (74) enthält, der zwischen dem Widerstand (50) und der Signalquelle verbunden ist, wobei die genannte Niedrigwiderstandsverbindung (76) zwischen dem Widerstand (50) und dem Transistorschalter (74) gebildet ist.
9. Der Heißtintenstrahldruckkopf nach irgendeinem der Ansprüche 1 bis 7, der ferner einen Transistorschalter (74) enthält, der zwischen dem Widerstand (50) und Signalquelle verbunden ist, wobei die genannte Niedrigwiderstandsverbindung (90) zwischen dem genannten Transistorschalter (74) und der genannten Signalquelle gebildet ist.
10. Ein Tintenstrahldrucker, der eine Mehrzahl von Druckköpfen jeweils gemäß irgendeinen der Ansprüche 1 bis 9 enthält, die im wesentlichen kollinear angeordnet sind, wobei die Heizelemente von jedem Druckkopf mit der ersten, gemeinsamen Leitung und den zweiten, gemeinsamen Leitungen verbunden ist, wobei die genannten zweiten, gemeinsamen Leitungen in Richtung zu der Rückseite des Druckkopfes so enden, daß den Heizelementen Leistung zugeführt werden kann.

Revendications

1. Tête d'impression à jet d'encre du type comportant une multitude de canaux (49a) chaque canal recevant de l'encre et ayant une ouverture qui sert comme buse d'éjection de gouttelettes d'encre (33), un élément chauffant (50) étant placé dans chaque canal, les gouttelettes d'encre (12) étant éjectées à partir des buses par l'application sélective d'impulsions de courant sur les éléments chauffants en réponse aux signaux de données provenant d'une source de signaux de données, les éléments chauffants transférant l'énergie thermique à l'encre entraînent la formation et la déformation de bulles de vapeur temporaires qui expulsent les gouttelettes d'encre, caractérisée en ce que la tête d'impression comprend de plus des premier et second retours de commun électriquement conducteurs (54', 70), les retours de commun étant interconnectés par des conducteurs (72) s'étendant entre les éléments chauffants, les éléments chauffants étant connectés entre le premier retour de commun et la source de signaux de données par une connexion à faible valeur ohmique (76 ; 90) qui est formée au-dessous ou au-dessus du second retour de commun.
2. Tête d'impression à jet d'encre selon la revendication 1, dans laquelle les premier et second retours de commun (54', 70) sont constitués d'aluminium et la connexion à faible valeur ohmique est une diffusion n⁺ dans une pastille de silicium de type p.
3. Tête d'impression à jet d'encre selon la revendication 1, dans laquelle les premier et second retours de commun sont constitués d'aluminium et la connexion à faible valeur ohmique est du polysilicium fortement dopé sur un oxyde de champ.
4. Tête d'impression selon la revendication 1, dans laquelle les premier et second retours de commun sont constitués d'aluminium et la connexion à faible valeur ohmique est un siliciure de métal formé sur du silicium n⁺ ou p.

EP 0 370 817 B1

5. Tête d'impression à jet d'encre selon la revendication 1, dans laquelle les premier et second retours de commun sont constitués d'aluminium et la connexion à faible valeur ohmique est un empilage de siliciure/polysilicium.

5 6. Tête d'impression à jet d'encre selon la revendication 1, dans laquelle les premier et second retours de commun sont constitués d'aluminium et la connexion à faible valeur ohmique est de l'aluminium.

10 7. Tête d'impression thermique à jet d'encre selon l'une quelconque des revendications 1 à 6, dans laquelle le premier commun (54') présente une largeur se trouvant dans une plage située entre 25 à 300 μm .

15 8. Tête d'impression thermique à jet d'encre selon l'une quelconque des revendications 1 à 7, comportant de plus un commutateur à transistor (74) connecté entre la résistance (50) et la source de signaux, la connexion à faible valeur ohmique (76) étant formée entre la résistance (50) et le commutateur à transistor (74).

20 9. Tête d'impression thermique à jet d'encre selon l'une quelconque des revendications 1 à 7, comportant de plus un commutateur à transistor (74) connecté entre la résistance (50) et la source de signaux, la connexion à faible valeur ohmique (90) étant formée entre le commutateur à transistor (74) et ladite source de signaux.

25 10. Imprimante à jet d'encre comportant une multitude de têtes d'impression, chacune selon l'une quelconque des revendications 1 à 9, montées pratiquement de manière colinéaire, les éléments chauffants de chaque tête d'impression étant connectés au premier commun et les seconds communs étant interconnectés, les seconds communs se terminant vers l'arrière de la tête d'impression de façon à permettre l'acheminement de l'alimentation aux éléments chauffants.

30

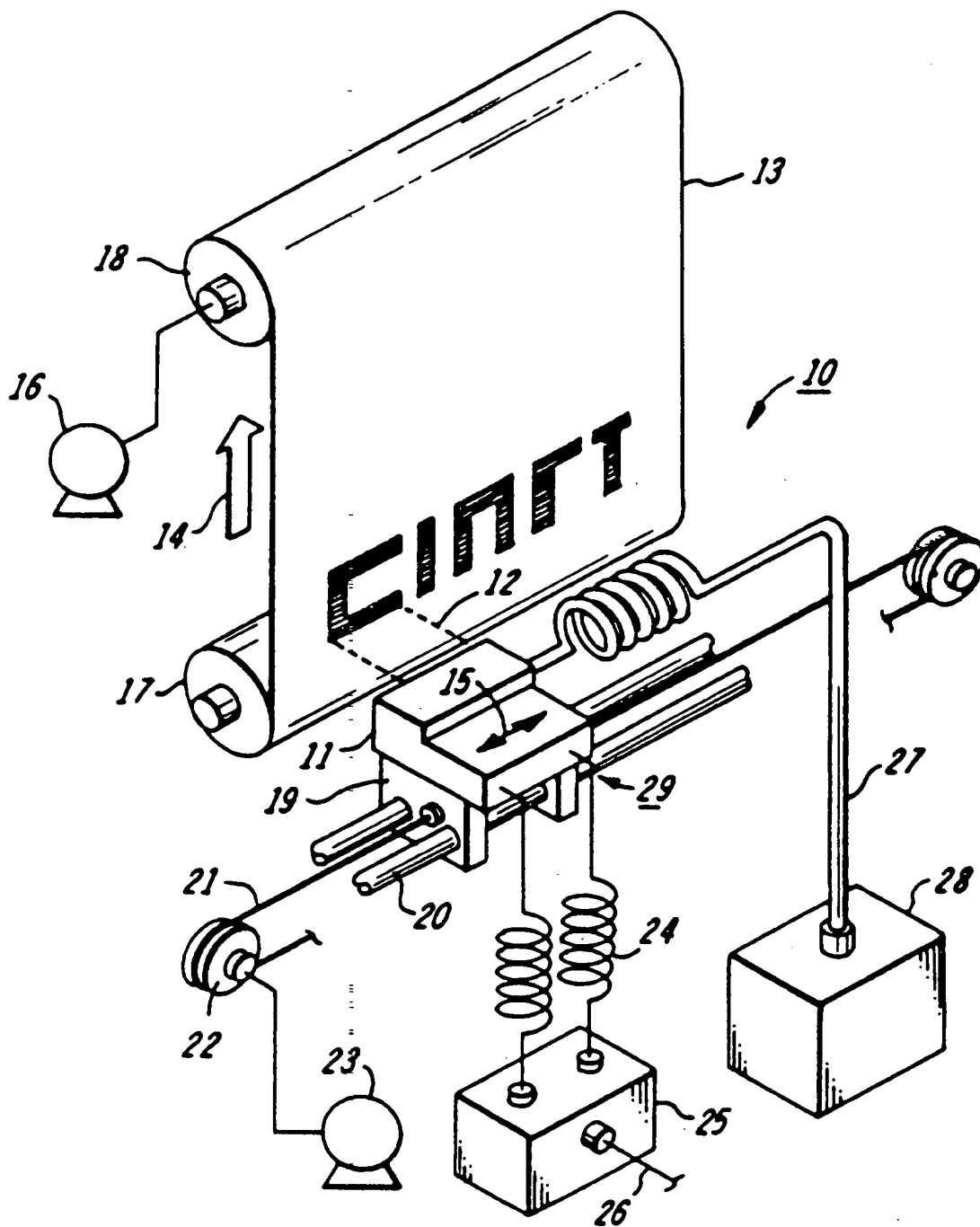
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PRIOR ART

FIG. 1

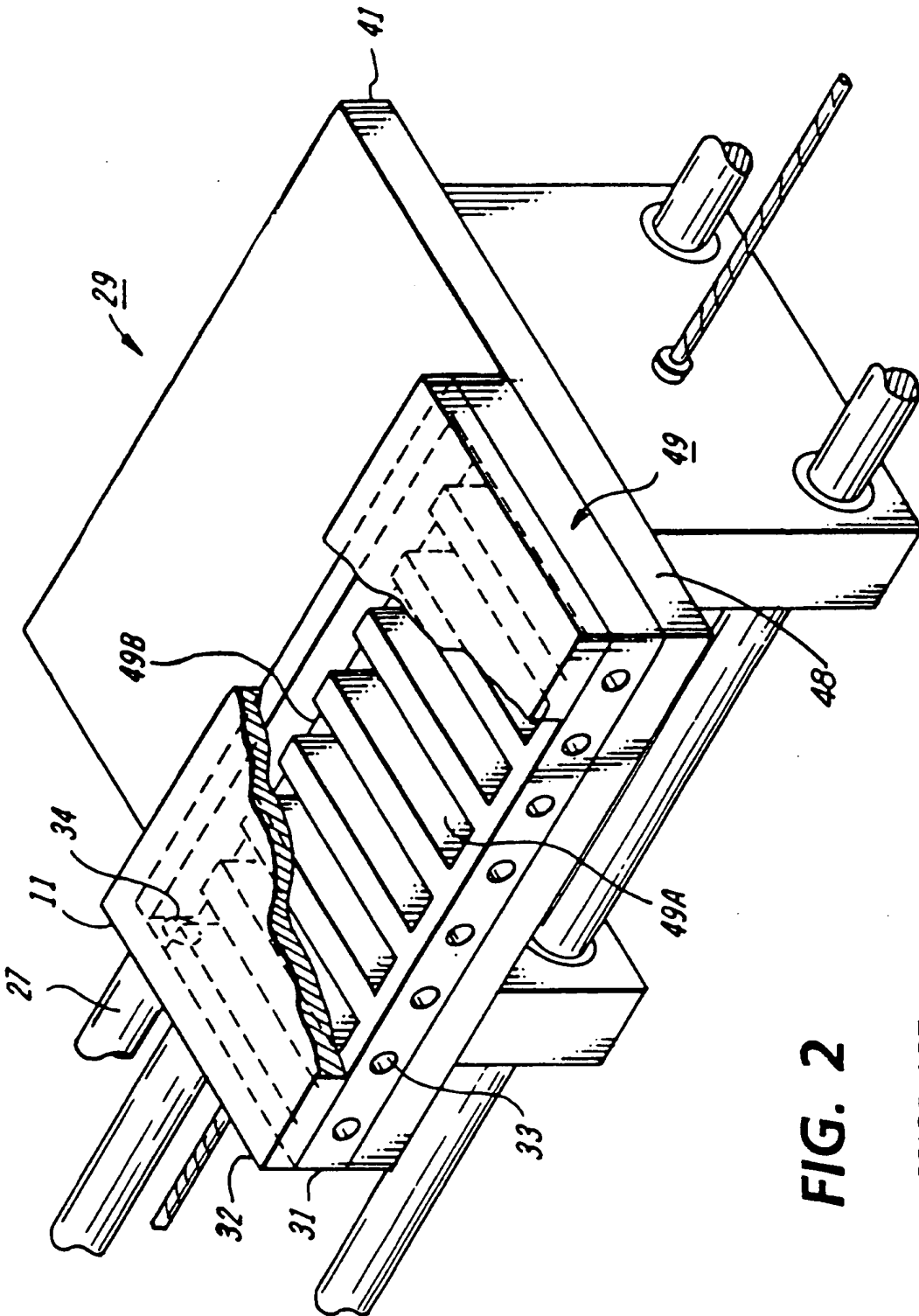


FIG. 2

PRIOR ART

FIG. 3

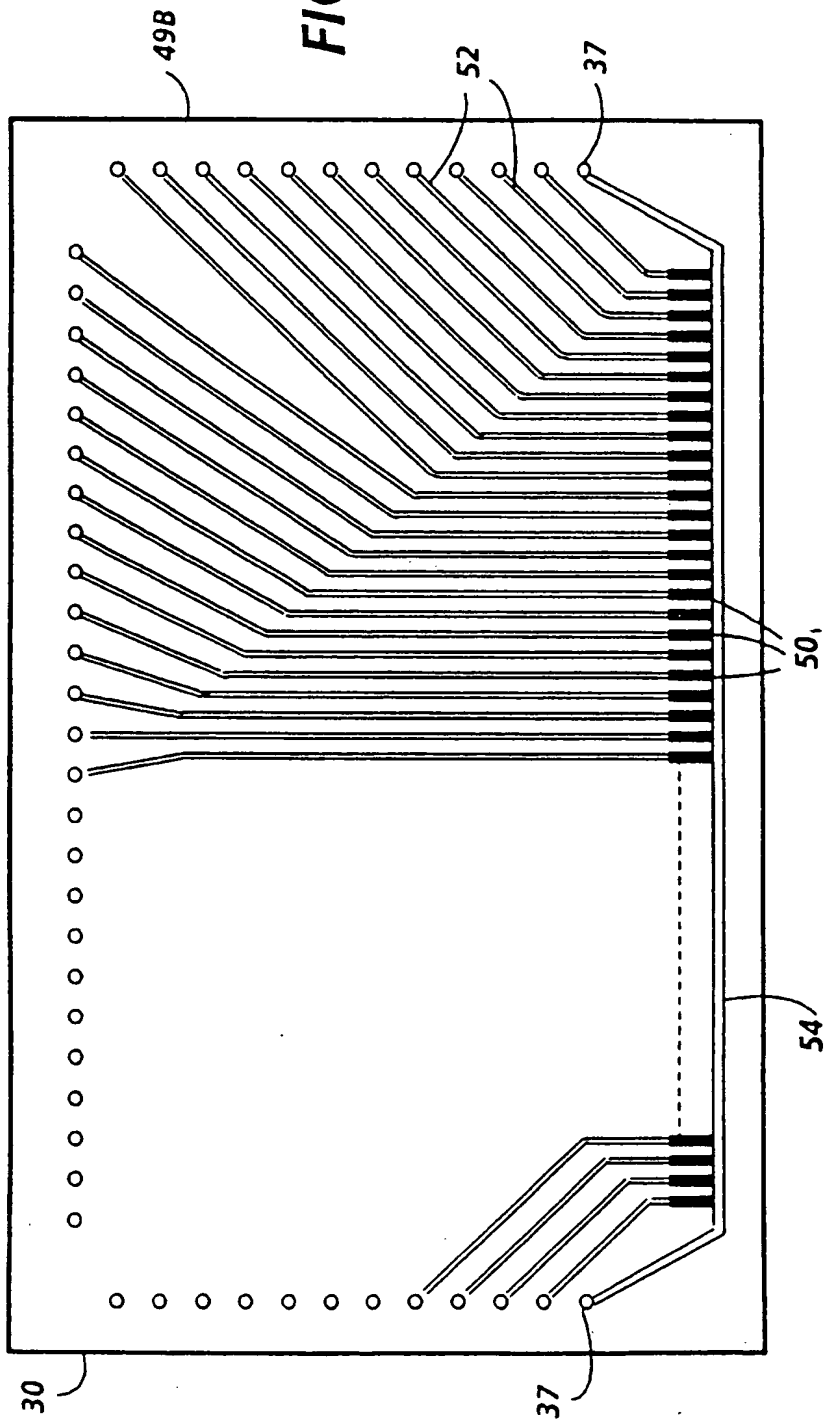
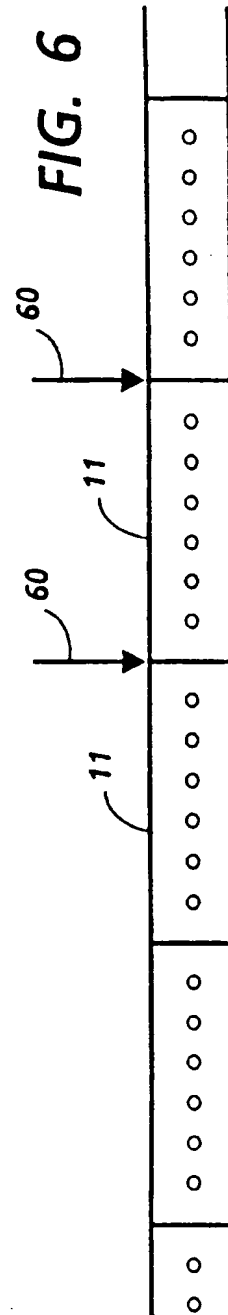
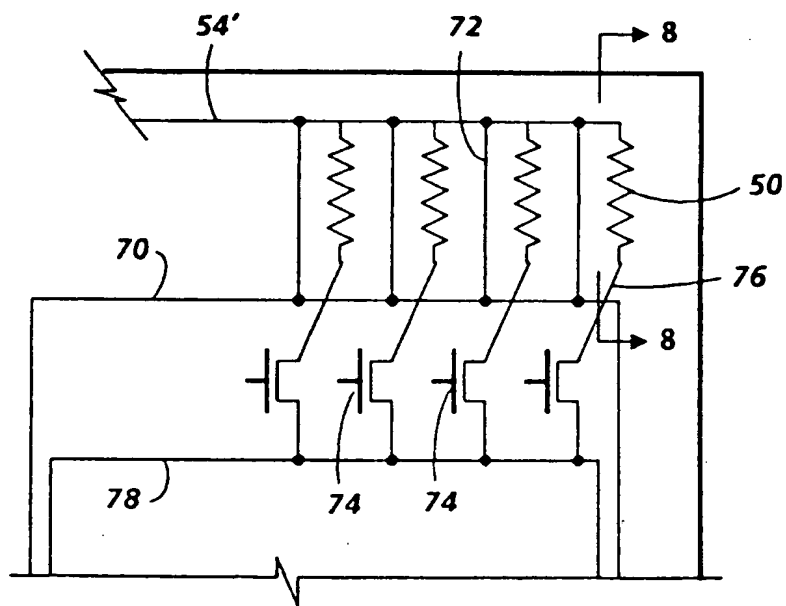
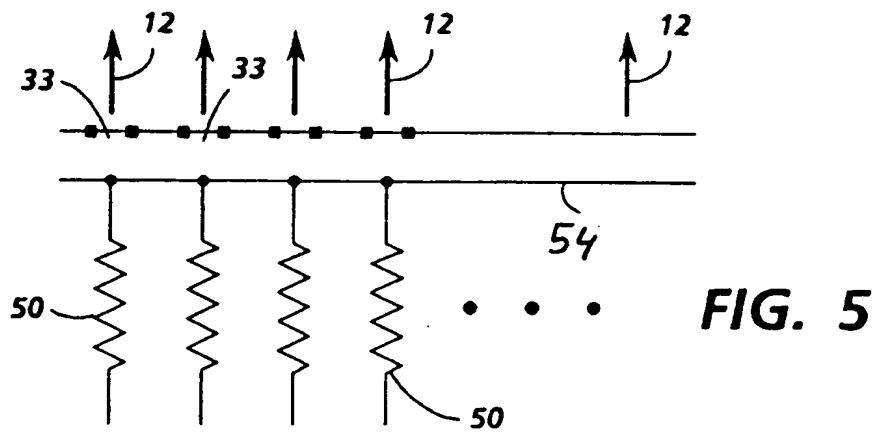
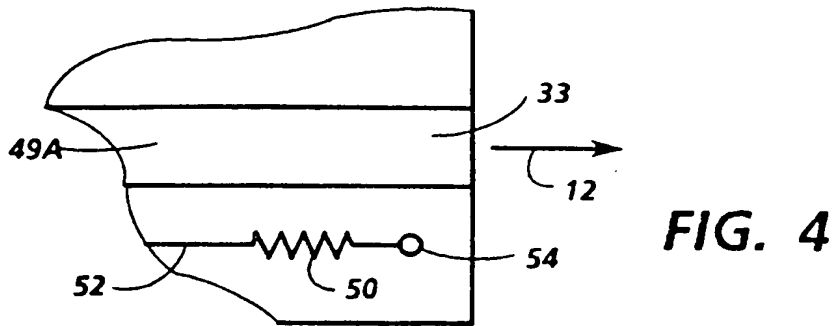


FIG. 6





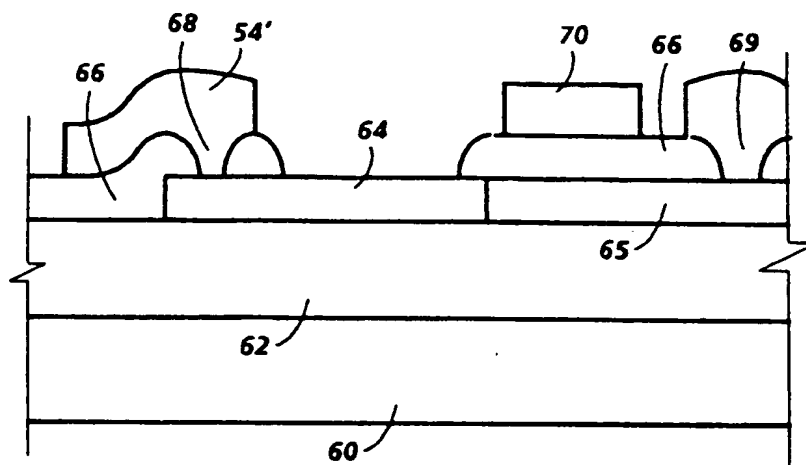


FIG. 8

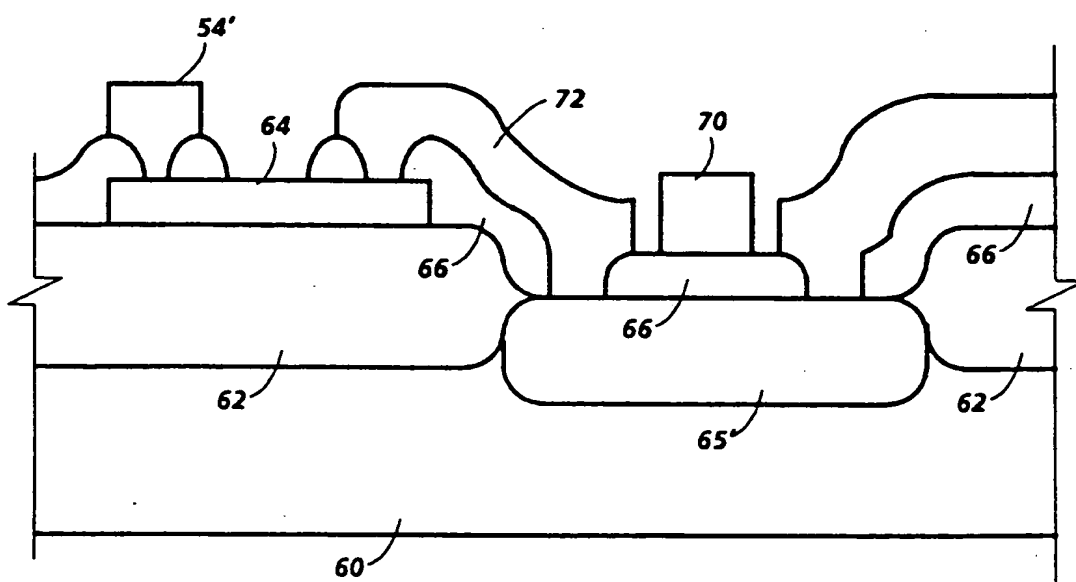


FIG. 9

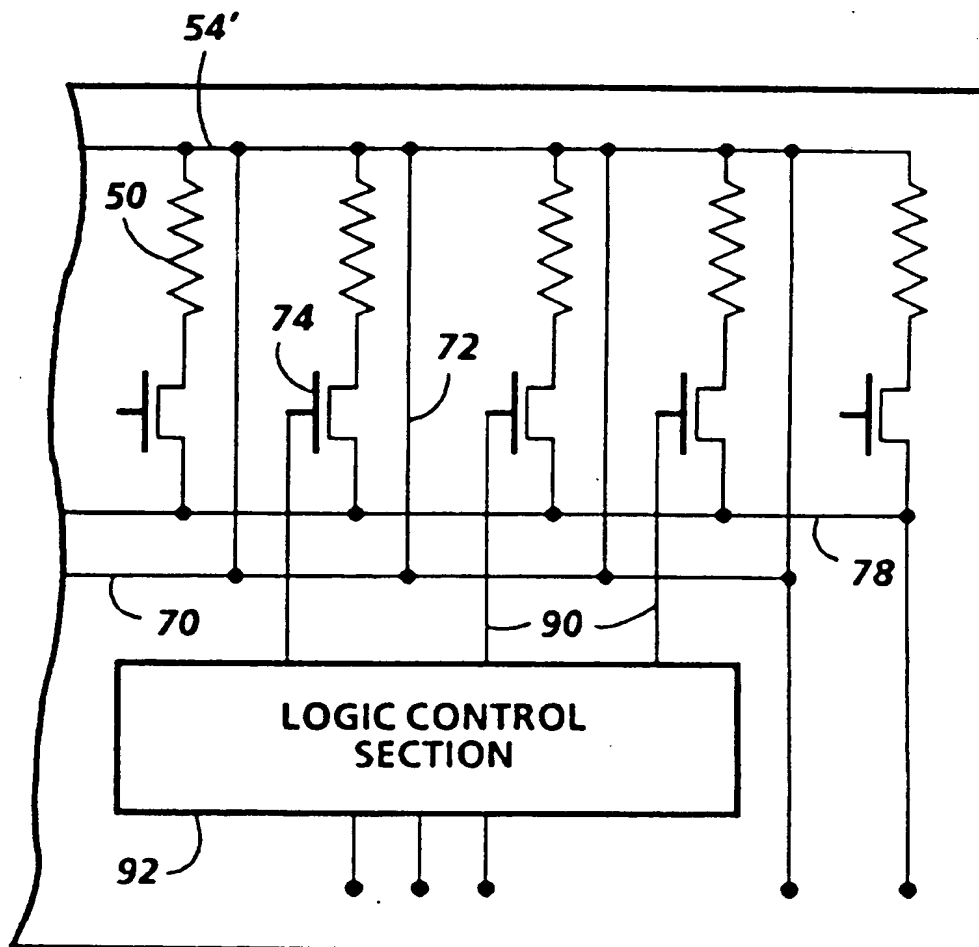


FIG. 10